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tion of the Indiana "Block Coals." He believed they would become sources of vast wealth. But his friend Prof. Cox must not be sure other states would not furnish the same quality of coal.

He had for many years burned a coal which is so much like Indiana Block Coal, that Prof. Cox himself could not distinguish them.

But no opportunity had been offered for publishing the results of the Missouri Survey.

NUMERIC RELATIONS OF THE VERTEBRATE SYSTEM.—BY DR. T. C. HILGARD.

THERE are five (not four only) complete neural rib arches to the cranium of all vertebrate animals, to wit: (1) The condylar or sensitive belt with the condyle plates for side ribs and the lower arch of the *transversely bipartite* occiput for its vault piece; (2) the petrosal or *acoustic*, containing the auditory nerves in its side beams (easily detected by removing the ear drum of Felines, etc.), and overarched by the anterior belt of the occipital squama; (3) the parietal belt originally containing the true gustative nerve of fixed tastes (sour, sweet, salt and bitter, the glosso-pharyngeal), in an incision; from which it is, however, soon crowded out by the internal carotid artery and the overlapping "acoustic rib blade." The next (4) is the optic or frontal, visibly succeeded, in fishes, by (5) the ethmoidal or olfactory vertebra. The rest of the cranium is formed by its "extremities" or prehensile appendages.

The same numeric law which pervades the entire vegetable kingdom reoccurs in the human fabric in a very marked manner.

The number of "radiating elements" in a coil or whorl, or of whorls in a cycle, or in cycles generally speaking, as in pine cones and flower buds, etc., are the following:

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, etc., progressing by the summation of the last two numbers.

The bands or parallel coils of flowers or scales in pine cones, sunflower discs, etc., embody these numbers successively, as they grow steeper and steeper, alternately on the right and left. The vertical bands, or columns, give the number of parts of the cycles involved.

The explanation heretofore given by me is this, that one element generates the other.

The elements are radial; they are bilateral rays, with a rift, so to speak, on the opposite side. It is there, where, in a like manner as the seed-leaves of flowering plants produce prolific "ovules," new radial organs are developed from the preceding ones—laterally at alternate heights and toward the wider spaces.

This process, referred to the radial organs of plants in an early stage, will yield:

1. The *numbers* of parts in question, successively.

2. The peculiar law of *interpolations* or of "divergence," viz.: by a number of interstices represented by the second preceding one of each cyclar number.

3. It will *conclude* the cycles, if it be supposed that the activity of each junior member depends on that of its progenital one; as in all cases of simple branch developments.

These numbers occur in like manner in the human frame, as follows:

Inclusive of the terminal (ossified or gristly) coccygeal element, we have exactly thirty-four spinal vertebræ.

Classifying nerves by their *work*, or "function," we find—

3 pairs of cervical nerves (neck).

5 pairs of bracchial nerves (arms).

8 pairs of pedal nerves, composed of 3 crural (lumbar) and 5 ischiadic (sacral) ones.

13 pairs of nerves to the rump.

5 specific ones of the cranium.

—

34 in all; whereas the number of the spinal vertebræ, which inclose the spinal cord is exactly 21.

There are five pairs of "extremities," organized after a common plan: (1) the lower, (2) the upper, (3) the temporal, (bearing the lower jaw for a "member,") (4) the palate-facial, with the upper jaw for its "member," (5) the opercular or hyo-tympanic one, forming the gill-lid in fishes or the tympanic ossicles in man; and the digital extremity of which is gradually converted into the (hand-like) crimped (external and internal) cartilages of the ear.

The five pair of hæmal arches of the cranium, *i. e.*, the gill arches of fishes, are gradually transformed into the gristles of the gullet, etc.

The main variation consists in the varying, but "cyclar" number of "rays,"—fingers, etc.; the varying cyclar number of their joints (1, 2, 5, 8, 13 respectively, in a dolphin, with five carpals, instead of eight, as in man) and the varying cyclar number of "loose" ossicles, such as *carpals*, *tarsals*, *teeth*, etc. The number of spinal vertebræ, is also variable, but not that of the cranial ones.

The vertebral blocks, as well as the ribs, are the product of the primitive axial series of (intervertebral) discs, which, when completely arrayed, each bear five branches, viz.: two pair of hæmal arches, two pair of neural arches, and a fascicle of parallel cleets, so to speak, which being *cemented* together, both in the front and rear, by the superficial ossification of the discs at either end are fused into the block pieces, as found, *e. g.*, in the young hog; the cementing slab covering the big neural rib head likewise, and not only the pentagonal prismatic block. The first disciform ossification we find in the corals, forming cribrose ethmoidal discs, such as the closely set "sigillate impressions" of the Astraea, and afterwards left behind as the coccyx, *e. g.*, of Cyathophyllum.

ON THE EARTHQUAKE OF OCTOBER, 1870. — BY COL. CHARLES WHITTLESEY.

THE writer confined his attention to what he pronounced the only remarkable feature of the earthquake, which was its occurrence at far distant points almost at the same moment of absolute time. Out of thirty odd observations made at as many different points in the United States, four were known to be accurate to within fifteen seconds, so that the total error could not exceed thirty seconds. Making the necessary allowance for difference of longitude, it occurred at Cleveland, Ohio, at 10 hours 43 minutes 30 seconds; at Albany, New York, 10 hours 43 minutes 9 seconds; at Boston, Mass., at 10 hours 43 minutes and 25 seconds; and at Bangor, Maine, at 10 hours 43 minutes and 19 seconds. The difference, therefore, was only in seconds. The ordinary rate of progression of earthquakes is from twenty to thirty miles an hour; while this one, if it progressed at all, must have moved at the rate of a thousand miles an hour. The paper was intended to raise the question: What kind of an earthquake was it?

Professor MCCHESNEY asked whether the author of the paper had given any attention to the subject in connection with the repulsion theories of Dr. Winslow of Boston.

Colonel WHITTLESEY stated that he had made very little progress toward a theoretical explanation of the phenomenon; he believed, however, that